Section 914. JOINT AND WATERPROOFING MATERIALS

914.01 General Requirements. Joint and waterproofing materials for use in concrete construction shall meet this specification.

914.02 Testing. Testing of steel joint materials shall be done according to ASTM E 8 or ASTM A 370 and the ASTM specification applicable to the material.

Testing of other materials shall be according to the current applicable specifications.

914.03 Fiber Joint Filler for Concrete Construction. Conform to the requirements of ASTM D 1751.

Fiber joint filler shall have such physical characteristics as not to be deformed or broken by ordinary twisting, bending, or handling when exposed to atmospheric conditions.

For concrete pavement, fiber filler shall be cut rectangular in shape to the width shown on the plans. Where holes for load-transfer bars are required, the holes shall be punched according to the plans. Holes in the filler for concrete pavement repair shall be punched at the site of the repair after the location of load-transfer bars is determined.

914.04 Joint Sealants for Concrete Construction.

A. **Hot-Poured Joint Sealant.** Conform to ASTM D 3405 and the following exceptions:

   1. **Bond.** The sealant shall be tested at -20 °F for 3 complete cycles at 100 percent extension.

   2. **Penetration At 77 °F.** The penetration at 77 °F shall be 130 ±20.

   3. **Penetration At 0 °F.** The penetration at 0 °F shall be not less than 40. Two specimens shall be prepared and tested after being conditioned for 24 hours at 0 °F. The test shall be completed within 20 seconds after removal from the freezer.

   4. **Fine Aggregate.** The fine aggregate incorporated into the concrete mixture used to make the bond blocks shall be 2NS sand.

   5. **Sampling and Testing.** A minimum of 14 days will be required between the time the sample is received and time of reporting test results.

   6. **Packing and Marking.** Containers in which the material is packed shall be legibly marked with a non-fading weather-resistant ink or paint. The markings shall include the manufacturer's name, or trade name, batch number, recommended pouring temperature, and the maximum safe heating temperature.

B. **Backer Rod for Use With Hot-Poured Joint Sealant.** The backer rod for use with a hot-poured joint sealant shall be a solid, round, heat resistant, closed-cell, cross-linked polyethylene foam rod conforming to ASTM D 5249, Type I.

C. **Preformed Joint Seals for Concrete Pavement.** The preformed joint seal shall meet ASTM D 2628, with the following exceptions and additions:

The seals for pavements shall not be coated internally with talc or any other release agent during or after manufacture.

Hardness, Type A durometer, shall be 60 ±5. Specimens shall consist of strips cut from the webs or walls of the seal. If the specimen is not at least 0.12 inch thick, two or more plies shall be used to obtain this thickness.

The low-temperature stiffening test is not required.

In the compression-deflection test, the compression-deflection value shall be calculated from the results obtained on the compression portion of the first cycle.

The seals for transverse joints in pavement shall meet the requirements of Table 914-1.

Table 914-1 Compressive Force vs. Deflection Requirements

Seal Width (inch)	Compressed Width (inch)	Compressive Force (lbs per inch)
11/16	0.55	4.0 min
	0.34	35.0 max
1	0.80	4.0 min
	0.50	35.0 max

The manufacturer of joint seals shall obtain Department approval of the shape of each joint seal before the submission of materials for acceptance testing. The request for this design approval must be in writing to the Construction and Technology Division. A 15-foot length of the proposed seal must accompany this request.

Each new size and shape of seal, from each manufacturer, shall be installed by the manufacturer in several sample joints before the submission of any individual production lots. This installation demonstration shall be witnessed by Construction and Technology Division personnel. At this time the inherent capabilities for satisfactory field installation will be demonstrated. The seal must not exhibit any twisting, rolling, misalignment of opposite top edges, tendencies to trap incompressibles, or any other qualities deemed by the Department to be detrimental to installation or function.

After a particular seal is given a design approval, each production lot thereafter shall maintain the shape and sealing abilities of the original approved sample. If installation and placement characteristics are not satisfactory due to an unsymmetrical seal cross section, the lot will be rejected. Seals for longitudinal joints in concrete pavements shall meet the dimensional requirements as shown on the plans.

Each lot of the finished seal for transverse joints in concrete pavement shall meet the dimensional requirements specified in Table 914-2.

Table 914-2 Dimensional Requirements for Neoprene Seals

Seal Width min. (inch)	Operational Flat Contact Surface for Each Side of Seal when Compressed to 80% of Seal Width (inch)	Overall Depth of Seal when Compressed to 50% of Seal Width (inch)
11/16	5/8 min.	1 ½ max.
1	3/4 min.	1 3/4 max.

1. **Marking.** Each lot shall be identified with a different lot number and the manufacturer's name printed at not more than 3-foot intervals on the seal. A lot shall consist of no more material than is produced in one continuous run within the same day (24 hour period).

2. **Testing.** Compliance with the physical requirements specified will be determined by tests conducted according to the methods specified using specimens cut or buffed from manufactured seals.

D. **Lubricant-Adhesive for Neoprene Joint Seals.** The lubricant-adhesive shall be a single-component moisture-curing polyurethane and aromatic hydrocarbon solvent mixture meeting ASTM D 2835, Type I.

Containers in which the lubricant-adhesive is shipped shall be plainly marked with the lot or batch number of the material and date of manufacture.

The lubricant-adhesive shall be stored at temperatures between 58 and 80 °F and shall not be more than 12 months old when used.

914.05 Epoxy Binder for Joint Spall Repair. The epoxy binder material to be mixed with dry 2MS masonry sand for the repair of spalls adjacent to longitudinal or transverse joint grooves shall consist of one of the following types. The type to be used shall depend on concrete temperature conditions at the time of patching.

Type I shall be used when the concrete temperature is within the range of 60 to 104 °F.

Type II shall be used when the concrete temperature is in the range of 35 to 60 °F.

Type I and Type II epoxy binders shall be formulated such that all components are of low viscosity and easily measured and mixed in the field. Both types shall be formulated to be mixed either at a 1:1 or a 2:1 ratio, by volume. The proper volumetric mix ratio shall be clearly indicated on both component containers. Both components of each type of epoxy binder shall be composed of 100 percent non-volatile materials containing no solvents and no pigments. All ingredients of the epoxy binder shall be reactive to become a permanent part of the cured adhesive system and must be able to tolerate small amounts of moisture which may be present in the concrete repair area.

The epoxy binders shall meet the requirements of Table 914-3.

Table 914-3 Epoxy Binder Physical Requirements

Test	Type I	Type II
Part A, Epoxy Resin Base Polymer Viscosity, poises at 72 °F (a) (Brookfield viscometer, No. 2 Spindle)	5 - 30	5 - 20
Part B, Modified Curing Agent Viscosity, poises at 72 °F (a) (Brookfield viscometer, No. 2 Spindle)	3 - 30	3 - 20
Mixture A and B Gel Time, minutes (100 g initially at 72 °F)	25 - 50	8 - 15
Tensile Strength at yield, psi at 72 °F (b)(c)	3000 min	2500 min
Elongation, Ultimate, percent (c)	10 min	10 min
Tensile Modulus of Elasticity, (b)(c) psi at 72 °F (initial tangent)	200 - 350	100 - 250
Absorption (24 hours in water at 72 °F) percent by weight (c)	1.0 max	1.0 max
Shear Bond Strength, psi (On sawed concrete at 72 °F)	400 min	400 min

a. Viscosity tests are performed according to ASTM D 1084, Method B.
b. Tensile tests are performed at 0.2 inch per minute according to ASTM D 638, Type 1 Specimen.
c. Tensile, elongation, and absorption tests are performed on specimens cut from a ⅛ inch thick cast sheet of cured epoxy binder.

Containers shall be plainly marked as to part, type, lot or batch number, and volumetric proportioning ratio. Test samples must be received by the Construction and Technology Division at least two weeks before intended use.

A batch of each component is defined as that quantity of material which has been subjected to the same unit chemical or physical mixing process intended to make the final product substantially uniform.

914.06 Epoxy Resin Adhesive. The epoxy resin adhesive shall be capable of being injected into and of traveling in a crack 0.005 inch wide. The epoxy adhesive shall be selected from the Qualified Products List.

The material for the temporary seal shall be a fast-setting grout or a fast-set temporary seal as recommended by the manufacturer of the epoxy resin adhesive.

914.07 Dowel Bars for Transverse Expansion and Contraction Joints. The dowels shall be straight, smooth, round bars conforming to the dimensions shown on the plans. Dowel bars shall have a minimum yield strength of 40,000 psi and a minimum tensile strength of 70,000 psi when tested after being welded to the dowel basket assembly, when welding is required.

Dowel baskets shall be from an approved source. The dowel bars shall be secured into the baskets by welding or some mechanical means such that the dowels will be able to withstand the forces imposed by concrete placement and still maintain alignment.

For expansion joints, the dowel bars shall be fitted with expansion caps as shown on the plans. Expansion caps shall be sized to provide a slip fit onto the coated bar which shall then be approved by the Engineer before they are used on the project. Expansion caps shall have a uniform diameter for a minimum length of 4 inches and shall have a suitable stop to assure that the end of the cap maintains a minimum distance of one inch from the end of the dowel bar during concrete placement. Metal expansion caps shall be fabricated from a minimum 28-gauge sheet steel and shall be entirely closed at the end by crimping. Plastic expansion caps shall be fabricated to a uniform minimum thickness of $^{1}/_{16}$ inch, shall be one piece, and entirely closed on the end.

For both expansion and contraction joints, the ends of the dowel bar shall be free of burrs and shall be saw cut or sheared. If sheared, there shall be no out of round deformation due to the shearing process.

Dowel bars shall be protected from corrosion by one of the following methods.

A. **Coatings for Dowel Bars.** The bars shall be coated with one of the epoxy resin coatings included on the Qualified Products List.

   Epoxy coated dowel bars shall have an average coating thickness not less than 0.010 inch, nor more than 0.014 inch on any bar, with individual determinations on a single bar within a tolerance of ±0.004 inches of the average. Coating is not required on the end faces of the bars and is not required on the cylindrical surface within 3 inches of the end that will be fixed in the supporting basket by welding or other mechanical means.

   To prevent bonding to concrete, epoxy coated dowels shall also be coated with a bituminous material meeting the requirements of MC-70, or RC-250, as specified in section 904; or an alternate bond release agent selected from the Qualified Products List. Asphalt coatings may be applied by the supplier or the Contractor. Alternate bond release agents shall be applied by the dowel basket assembly manufacturer. Bond release agents shall provide a pull-out shear bond stress of the dowel bar not exceeding 60 psi for initial and final movement of the dowel from the concrete specimen. The supplier of the bituminous material shall furnish certification that the coating material meets the specified requirements. The bond-breaking coating shall be applied to a sawed end of the dowel bar and for at least two-thirds of its length.

   The supplier shall designate the epoxy resin coating used and certify that the dowel bars were given a surface preparation treatment before coating according to the recommendations of the coating manufacturer. In addition, dowel bars will be sampled and tested for average coating thickness; chipped, cracked, or otherwise damaged coatings;

and for presence of a bond breaker, when required, before incorporation in the concrete construction. Dowels with coatings not meeting the requirements for thickness or having more than a minor amount of damage to the coating will be subject to rejection.

B. **Sleeves for Dowel bars.** The sleeve shall be made of 300 Series stainless steel, Monel metal, or other approved equivalent, and shall be a minimum of 0.01 inch thick. The sleeve shall be closely wrapped around the dowel bar so that there will be no movement of the sleeve in relation to the bar and no areas in which the sleeve is not in contact with the bar. Lack of contact will be determined by the formation of dimples in the sleeve when tapped lightly with a ball-peen hammer or similar tool. The lap shall be fastened with a folded lock seam or a continuous weld. The sleeve will not be required within 3 inches of the end of the bar which will be fixed in the supporting basket by welding or other mechanical means.

   In lieu of placing a sleeve on a carbon steel bar, a solid stainless steel bar may be furnished, provided it meets the other applicable requirements for dowel bars.

914.08 Devices for Transverse End-of-Pour Joints. Devices for end-of-pour joints shall be steel hook bolts or straight tie bars.

Hook bolts shall meet the requirements for hook bolts for longitudinal bulkhead joints in subsection 914.11.C.

Straight tie bars shall be No. 5 or larger steel deformed bars, 30 inches in length, and shall meet ASTM A 615, A 616, A 617, or A 706. Straight tie bars shall be epoxy coated according to subsection 905.03.C, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.

914.09 Lane Ties for Longitudinal Pavement Joints.

A. **Straight Tie Bars.** Straight tie bars shall be No. 5 or larger steel deformed bars, 24 inches in length, and shall meet ASTM A 615, A 616, A 617, or A 706. The tie bars shall be epoxy coated according to subsection 905.03.C, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.

B. **Bent Tie Bars for Bulkhead Joints.** Bent tie bars shall be No. 5 or larger steel deformed bars 24 inches or more in length as measured around the outside of the bend. The tie bars shall have a yield strength of not less than 40,000 psi, and shall have sufficient strength, ductility, and workability to withstand being bent to approximately a 90-degree angle, restraightened, and then withstand the pull-out test requirements in subsection 602.03.F. The tie bars shall be epoxy coated according to subsection 905.03.C, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.

C. **Hook Bolts for Bulkhead Joints.** Hook bolts for bulkhead joints shall consist of two hook bolts mechanically coupled to form a lane-tie assembly as shown on the plans. The lane-tie assembly shall have an ultimate tensile strength of not less than 24,000 psi. The threaded

portion of the hook bolts shall have nominal ¾ inch -10UNC threads and a shank diameter not less than a No. 5 bar, (Where an existing pavement is to be widened and the pavement contains smaller size couplings, the second half of the lane tie shall be a hook bolt of a size compatible with the existing coupling.) The lane-tie assembly shall have a means of preventing threading the hook bolts beyond the center of the coupling. The minimum embedment length for standard hook bolts on each side of the joint shall be 7 ⅝ inches.

D. **Expansion-Anchored Lane Tie Devices for Bulkhead Joints.** Expansion-anchored lane-tie devices for longitudinal bulkhead joints must meet Department approval before being used in the work. The Department will maintain a list of approved anchors which have met the minimum requirements for size and resistance to pull-out and slippage. Hook bolts used with expansion anchors shall have a thread size of ¾ inch or larger, as necessary for the type of anchor used, and a shank diameter not less than a No. 5 bar. The length shall be as necessary to engage the expansion anchor and extend beyond the face of the existing slab for a minimum of 7 ⅝ inches.

E. **Other Longitudinal Bulkhead Joint Devices.** Bulkhead joint devices other than bent bars, hook bolts, and expansion-anchored devices shall have a shank diameter of at least a No. 5 bar and such additional size as necessary to provide for nominal ¾ inch-10UNC threads. They shall have sufficient length and such configurations that, when properly installed in concrete, they will withstand a pull-out test of 12,000 pounds without slippage in excess of $^{1}/_{32}$ inch. The second half of mechanically coupled devices shall have the same configurations and embedment length as the first half or shall be a hook bolt having the minimum embedment length specified.

914.10 Structure Expansion Anchors and Bolts. Expansion anchors of the size and shape shown on the plans shall be selected from the Qualified Products List. Bolts used with flush-type anchors shall meet ASTM A 307, Grade A.

914.11 Preformed Waterproofing Membranes and Joint Waterproofing. Preformed waterproofing fabric system, including the manufacturer's recommended primer, shall be selected from the Qualified Products List.

914.12 Elastomeric Bearings. Elastomeric bearings shall conform to the requirements for 100 percent virgin polychloroprene (neoprene) bearings as specified in Division II, Section 18.2 Elastomeric Bearings, AASHTO *Standard Specifications for Highway Bridges.* Laminated bearings shall have a shear modulus (G) of 100 psi (±15 psi) and plain bearings a shear modulus of 200 psi (±30 psi). Certification shall be provided by the fabricator that the bearings conform to these requirements.

Laminates shall be rolled steel sheets conforming to ASTM A 36 or A 570, Grade 36 or 40. The surfaces of the laminates to which elastomers are to be bonded shall be blast cleaned.

914.13 Non-Metallic Washers. Non-metallic washers required for use as spacers between the pin plates and the link plates shall be polyethylene, high density, black, ASTM D 1248, Type III, Class B.

914.14 Polyester-Asphalt Hot Mix Membrane for Bridge Deck Waterproofing.

A. **Asphaltic Material.** The asphaltic material for the polyester-asphalt mixture shall be asphalt cement, as specified on the plans.

The bond coat shall be asphalt emulsion, MS- 2a or SS-1h.

B. **Aggregate.** The Contractor shall notify the Engineer before blending the aggregates. The aggregate shall consist of a uniform blend with 40 to 60 percent fine, dense-graded crushed stone screening and the remainder being round natural siliceous sand. Inherently porous mineral aggregates, such as blast-furnace slag, expanded shale, porous limestone, and lightweight aggregates will not be permitted.

Sufficient mineral filler shall be added to the blend of fine aggregates to meet the gradation limits in Table 914-4 for the polyester-asphalt mixture.

Table 914-4 Mineral Filler Gradation

Sieve Size	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
% of Total Aggregate Passing (a)	100	98-100	80-95	60-88	40-70	20-45	10-35	5-12

a. The preferred gradation falls near the upper limit at the coarse end and near the lower limit at the fine end.

C. **Mineral Filler.** The mineral filler shall consist of limestone dust, Portland cement, fly ash, or other material approved by the Engineer. It shall be dry and free from lumps.

D. **Polyester Fiber.** The polyester fibers shall meet the following requirements:

Average length . . . . . 0.17 inch
Average diameter . . . . . 0.00063 inch
Specific gravity 1.38
Melting temperature . . . . . 480 °F minimum
Ignition temperature . . . . . 1040 °F

The polyester shall be packaged in low-melt polyethylene bags which shall be introduced unopened into the pugmill.

The Contractor shall provide written certification from the polyester supplier that the polyester supplied for the mixture meets the minimum requirements specified.

While stored at the batch plant, the polyester shall be suitably protected from moisture. Any polyester which is wet or damp shall not be used in the mixture.

E. **Composition of Polyester-Asphalt Mixture.** The mixture shall be proportioned to the following job mix formula.

Material	Percent of Total Weight of Mix
Fine aggregate and filler	88-92%
Asphalt	9-12%
Polyester fibers	0.25%

F. **Plant Requirements.** The mixing plant shall be a batch-type plant. The automatic proportioning and cycling controls may be operated in the semi-automatic mode.

G. **Preparation of Aggregate.** The fine aggregates shall be uniformly blended by methods meeting the approval of the Engineer.

H. **Preparation of Mixture.** The method employed by the Contractor for introducing polyester into the pugmill shall be subject to approval of the Engineer so as to ensure proper distribution of polyester and avoid fiber clusters in the mixture.

The polyester shall be added to the pugmill in unopened bags after the aggregate and filler. The batch size shall be selected such that whole bags of polyester will be required. No splitting of bags will be permitted.

The aggregate shall be dry mixed for a minimum of 30 seconds after all of the polyester has been added to the pugmill.

After addition of asphalt to the pugmill, the complete mixture shall be mixed for as long as necessary to obtain a complete coating of aggregate and polyester fibers but in no case less than one minute.

The aggregate shall be heated to the temperature, normally 400 to 450 °F, required to achieve a final mix temperature of 375 ± 25 °F.